College Students Responding to Sexuality-Based Items: A Differential Test Function Analysis

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Abstract:

Surveys are often intended to collect data across a swath of individuals yet sometimes the items favor certain respondents over others. Differential test functioning (DTF) analysis helps us understand if there are underlying latent characteristics that may affect the way a group of individuals responds to items. This study sought to examine if differences existed in the responses to items pertaining to college students' feeling safe and supported regarding their sexual orientation. Results indicate that there appears to be differences in an item for queer first year respondents, but no differences when looking at senior students. More research is needed to precisely understand which items are functioning differently.

Keywords: queer, sexual orientation, higher education, item response, survey research

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The environments on college campuses are often unwelcoming for queer students (Dilley, 2002; Garvey & Rankin, 2015; Goldrick-Rab et al., 2019; Harley, et al., 2002; Longerbeam et al., 2007). Survey research is frequently used to grasp a better understanding of the lived student experience. The benefits of survey research are that data are often collected in a consistent form, there is usually no need to control for a certain treatment or group, and they are useful in testing hypotheses (Kelley et al., 2003). However, survey research operates under the notion that each individual item is interpreted and answered with similar comprehension of all respondents however, if this is not the case then issues can arise such as biased data (Choi et al., 2011). Rankin and Garvey (2015) urged survey methodologists to consider the complexities of social identities to prevent ignoring understudied populations.

Scholars point out the lack of quantitative research on sexual orientation and that surveys should be rigorously tested to assure research can accurately report findings (BrckaLorenz et al., 2019; Garvey, 2019; Renn, 2010). As such, this paper explores students' responses to a series of items asking about their sense of belonging as it pertains to their sexual orientation. It provides an overview of the college experience, challenges in researching, and survey methods for better understanding differences, for queer students. The study is exploratory in nature, seeking to understand differences in student responses to a set of items asking about their sexual orientation in relation to feeling a sense of belonging. The research question that guided the study is: what differences exist between survey responses to sexual identity items by student characteristics?

Conceptual Framework

At the core of every student it is posited there are attributes and characteristics that help them view the world (Jones & McEwen, 2000). The Model of Multiple Dimensions of Identity

(MMDI) assists scholars in making sense of students' identities (e.g., sexuality) and the way they interact with their internal foundation. Moreover, the framework urges researchers to view the complex nature of a student's identity as it is frequently a conglomerate of many sociological constructs (Jones & McEwen, 2000). Identities interact with one another, making it critically important to view multiple dimensions. For example, it would be a disservice to the queer and trans communities to examine their existence as a monolith because there are demonstrated differences (Garvey & Rankin, 2015). Nuances are present among race as well; there are differences in how gay or bisexual men make meaning of their sexuality when also African American (Patton, 2011). The model helps lay foundation of the study as a number of student demographics are examined in relationship to items about sexual orientation.

The MMDI works in conjunction with principles from Item Response Theory (IRT). The latter has two main goals: to remove poor performing items, and to compare items that differ in difficulty (Thissen, 2016). It calls on scholars to search for survey items that are inherently biased against certain populations when the probability of students responding in similar manners are equal (AERA, APA, & NCME, 2014). This is critically important as discrepancies can be harmful to subsequent results e.g., misrepresenting a population. The MMDI focuses attention on multiple identities while IRT urges a close examination of item responses. The present study employs a type of differential item functioning (DIF) analysis, helping assess biases in measures when students have the same ability for answering a group of items in a similar manner, but their propensity is different (Wright & Stone, 1979).

Literature Review

Three bodies of research serve to provide guidance for the study. Extant scholarship on the queer student experience, methodological considerations for examining queer students, and a

review of item response theory help situate the current study. It is important to note the language used in this section aims to honor the original authors' intentions and students' identities while this paper will use queer to refer to the population being presently studied. Moreover, the term non-queer is used to depict the heterosexual or straight community to disrupt traditional power structures.

Collegiate Environments for Queer Students

The canon of queer research is considerably small given the centuries higher education has existed. Arguably, the most insightful work of literature pertaining to the queer student experience emerged in the early 2000s. Dilley (2002) chronicled the experiences of gay men from the 1950s to 1990s learning about what they endured. Similar to the national view of queerness, many of the participants in Dilley's study discussed being verbally assaulted and threatened to be expelled. It is no surprise that the oppression queer individuals face cause them to turn to destructive behaviors; "…Gay men are significantly more likely than other groups to consume alcohol to fit in and to feel more comfortable in a social setting" (Longerbeam et al., 2007, p. 224). Collectively, LGBT students are more than twice as likely to attempt suicide as their heterosexual peers (Harley, et al., 2002). Embedded in higher education is the potential for a negative bias toward the queer student experience.

Often, the most difficult experience of a queer student is coming-out. In retrospect, queer college students discussed how they served in the military and had to remain closeted or face a dishonorable discharge (Garvey, Sanders, & Flint 2017). Moreover, queer collegians expressed remaining closeted because of fear of on-campus ramifications (Garvey et al., 2017). Being out on campus has significant costs for queer students (Garvey & Rankin, 2015); students could be expelled, bullied, or murdered (Dilley, 2002; Ott & Aoki, 2002). Sharing one's sexual orientation

with another individual is an emotionally taxing event. Students frequently grapple with their sexuality, determining when it is appropriate to come-out (Dilley, 2002). Students shame and hate themselves, thinking they are unnatural; Dilley (2002) identified several students who hid behind religion and inauthentic heterosexual marriages. It is not surprising then to find LGT students report higher rates of housing insecurity and homelessness than heterosexual students (Goldrick-Rab et al., 2019). Queer students who are liberated do not have it easy either; Renn and Bilodeau (2005) discovered LGBT student leaders are put in difficult positions as they are forced to speak on behalf of their entire community and face potential backlash from administrators. Due to the stressors surrounding students' sexual orientation it is plausible they may be uncomfortable sharing their identity with others.

Students who identify as queer often have a vastly different college experience than their peers. In a study on climate for LGBT individuals, Rankin (2005) unearthed, "Forty-one percent of the respondents stated that their college or university did not thoroughly address issues related to sexual orientation or gender identity" (p. 19). This is not surprising as other studies discovered more than one-third of LGBTQ students have experienced harassment (Blumenfeld, Weber, & Rankin, 2016; Rankin, 2005). Generally speaking, LGBTQ students perceive their campus climate less positively than their heterosexual peers (Yost & Gilmore, 2011); this may be why queer students are less likely to engage with their campus environment (NSSE, 2017). Specifically, bisexual students reported lower perceptions of campus climates than gay and lesbian students (Dugan & Yurman, 2011). To that end, LGBT students are one-third more likely to depart their institution than straight peers (Blumenfeld et al., 2016; Harley et al., 2002). Marginalized students internalize their campus climate thus if they continue to perceive themselves as being unwanted then they may not stay (Harper & Hurtado, 2007).

Challenges Researching Queer Students

Observing the queer experience is difficult as the population is numerically small, and a chilly climate persists on college campuses. In a multi-institutional national study, researchers found approximately 1% of college students identify as gender non-binary and 9.7% hold a marginalized sexual orientation (NSSE, 2017). LGBT students are often treated as "others" on campuses due to the heteronormative structures that exist (Evans & Herriott, 2004); this could affect their response rates as queer students fear being outed. However, researchers found that aging LGBT individuals appear to be more open, participating in survey research at higher rates than their heterosexual counterparts in studies (Lee et al., 2015). Thus, it may be expected that students who are older may respond to items regarding their sexual orientation differently than younger students.

Sexual orientation is a complex identity making it difficult to capture on surveys. The Williams Institute (2009) recommended asking about three different dimensions of the identity: how one identifies, the identities of one's sexual attraction, and the identity of one's sexual partners. It is important to consider the salience of all items to all participants in a survey to develop an instrument that is appropriate (Rankin & Garvey, 2015). The more items pertaining to sexual orientation on surveys allows researchers to be more precise with their analyses. Moreover, sexual orientation is often compounded by multiple identities; this is seen when examining race and ability status e.g., queer Latino students face more adversity than their peers, and LGBQ+ students with disabilities feel less part of their campus community than their able-bodied peers (BrckaLorenz et al., 2019; BrckaLorenz et al., forthcoming).

There are however drawbacks to survey research including, low response rates, data that are too broad, and too much data to fully analyze (Kelley, Clark, Brown, & Sitzia, 2003). A

major challenge facing quantitative researchers is the lack of data sets inclusive of sexual identity demographic (Garvey, 2014, 2019; Rankin & Garvey, 2015). In regard to college admissions, the University of Iowa was the first public institution in the U.S. to collect students' sexual orientation and gender identity on its application (Rankin & Garvey, 2015). Although the Common Application includes gender identity related questions it does not have an item asking students about their sexual orientation (Common Application, 2019). In a review of six U.S. federal surveys, Garvey (2019) found that none of them collected individuals' sexual orientation. In health-based studies, Fredriksen-Goldsen and Kim (2017) found it difficult to recruit LGBT participants due to small the numerical population.

Differential Item Functioning Analysis

Differential item functioning occurs when the probability of answering an item "correctly" favors a particular group of individuals (Berger & Tutz, 2016). DIF analyses have been conducted among a number of groups including; race, classroom type, faculty rank, and sex (see Cohen & Bolt, 2005; Paulsen et al., 2019). There is less known about item response patterns of individuals who identify as gender nonbinary or belong to the LGBQ+ community. This is likely due to the fact these populations are considered to be numerically small (Fredriksen-Goldsen & Kim, 2017), and the demographic data has historically and currently is not collected on many higher education surveys (Garvey, 2014, 2019).

Analyses may be skewed if the items are not functioning properly because groups being compared are not necessarily being compared fairly or the items are biasing one group over another (Paulsen et al., 2019). There are two types of DIF: uniform and nonuniform; the prior assumes that the groups of individuals' responses are affected in the same manner while the latter assumes there are unique differences in the groups underlying abilities or response patterns

(Berger & Tutz, 2016). This study operates from a nonuniform DIF lens assuming that students have the same abilities but there are unique differences in their responses. There are also multiple methods used to notice DIF in items however this paper uses a more flexible option than others and it is easier to comprehend (Choi et al., 2011; Paulsen et al., 2019). Specifically, differential test functioning (DTF) pertains to a group of items that operate together to measure a specific construct (Wright & Stone, 1979). To that end, the Graded Response Model tests if DIF exists among multiple choice items where the level of "correctness" varies as opposed to items where the correct response is either right or wrong (Dodd et al., 1989; Samejima, 1969). This is an important distinction as surveys often do not have an answer that is correct as there would be on an exam.

Methods

Data

The data for this study come from the 2017 administration of the National Survey of Student Engagement (NSSE). The instrument examines the time and effort students place toward meaningful educational opportunities as well as their overall collegiate experiences at four-year bachelor granting institutions (NSSE, n.d.). During this cycle, an additional set of items were appended to the core survey asking students about their sexual orientation; over 13,000 students across 31 institutions responded to the items. Additional information about where students in the study are enrolled can be found in Table 1.

Measures

Students responded to a number of demographic questions as part of the survey (Table 2). Students could select the following regarding their sexual orientation: (a) heterosexual(straight), (b) bisexual, (c) gay, (d) lesbian, (e) queer, (f) questioning or unsure, (g) another sexual

orientation (write-in), or f) prefer not to respond. The responses were dichotomously recoded into queer and non-queer while prefer not to respond were dropped for analysis (see Williams, Institute, 2009). Regarding their gender identity, students could select (a) man, (b) woman, (c) another gender identity (write in), or (d) prefer not to respond. The item was recoded into non-trans and trans and gender nonbinary with prefer not to respond dropped for analysis. Students could also report their race/ethnicity by selecting: (a) American Indian or Alaska Native, (b) Asian, (c) Black or African American, (d) Hispanic or Latina/o, (e) Native Hawaiian or Other Pacific Islander, (f) White, (g) Another race or ethnicity, or (h) prefer not to respond. The item was recoded dichotomously for analysis to Students of Color and white while prefer not to respond was dropped. Students were asked if they had a disability: (a) yes, (b) no, (c) prefer not to respond; where prefer not to respond was dropped. Further students responded to an item asking about their parents' or guardians' education with options to select: (a) did not finish high school (b) graduate from high school, (c) some or completed college or CEGEP, (d) completed a bachelor's degree, (e) completed a master's degree, (f) completed a doctoral or professional degree where the responses were re-coded as first-generation or not first-generation. Lastly, students responded to their academic class level (a) freshman, (b) sophomore, (c) junior, (d) senior, and (e) other.

All students were asked items pertaining to their sexual orientation. Students were asked with respect to their sexual orientation (straight, LGBQ+, etc.) the extent to which they felt physical safe, comfortable, valued, and part of the campus community at their institution (1=Strongly disagree, 2=Disagree, 3=Somewhat disagree, 4=Somewhat agree, 5=Agree, 6=Strongly agree). Students also answered how comfortable they were with people knowing

their sexual orientation (1=Very uncomfortable, 2=Uncomfortable, 3=Somewhat uncomfortable, 4=Somewhat comfortable, 5=Comfortable, 6=Very comfortable).

Respondents

The students in the study are first years (43%, n= 5,873), and seniors (57%, n= 7,878). The majority of the students identify as non-students of color (58.8%, n= 8,420) and, most of the students are from non-STEM majors (72%, n=10,929). Students mainly identify as non-trans (98.9%, n=14,873), and more than one in ten students identify as queer (12.3%, n= 1,798). There was nearly an even split of half first generation (41.1%) and non-first generation (58.9%) students. Students who reported a disability were over one in ten students (12.5%). For a complete list of student characteristics see Table 2.

Analysis

Prior to conducting analyses, data were examined and transformed to be appropriate for the methodology (Table 3). Unidemensionality was tested and a scale was created based on the items about students feeling part of their community in relation to their sexual orientation, called "institutional support" ($\alpha = .817$); students had to respond to at least 4 out of the five items of the construct to be counted. The creation of the scale was important as there should be a minimum of three items per scale to attempt to observe DTF in associated items (Paulsen, Merckle, & BrckaLorenz, 2019); there has to be variance for detection. DTF detection occurred by using the package lordif in the software R Studio leveraging a logistic regression foundation (Choi, Gibbons, & Crane, 2016). Specifically, this was achieved by computing pseudo R^2 and measuring the change between the two groups under observation (queer and non-queer). Gelin and Zumbo (2003) found that a value that was less than .035 is trivial and greater than .07 was large thus these cut points served as thresholds; anywhere in between would be considered

moderate dif. The package uses a graded response model to test the items as they are not dichotomous

Limitations

The study advances and builds upon previous studies focusing on differential test function analysis however there are some limitations that should be acknowledged. Logistic regression, the underlying statistical procedure for this study, operates with dichotomous variables. Comparing dominant and non-dominant student populations can often be perceived as deficit oriented; the aggregation of student populations limits the centering of student voices (Malcom-Piqueux, 2015). The Williams Institute (2009) encouraged researchers to separate out subgroups within sexual orientation because there are often differences between populations. It is important to acknowledge that each subpopulation has a unique collegiate experience. Lastly, the findings are based on students at institutions that self-selected to participate in NSSE thus it is possible that students from a different set of institutions would have different responses.

Results

When looking at first-year students' response patterns to feeling supported by their institution it appears there are some differences (Table 4). Moderate dif was found in the item pertaining to students' comfort level of others knowing their sexual orientation when the pseudo R^2 was .035 for students who identify as queer. Trivial changes in item responses were detected for students who identified as queer on all other items with the pseudo R^2 at .001. Trivial dif was also detected for Students of Color and STEM students in an item pertaining to feeling physically safe with respect to their sexual orientation with the pseudo R^2 at .001. This pattern was detected for Students of Color regarding their comfort level as well. There did not appear to be differences by gender, ability, or first-generation status. The test response curve and item trait

distributions demonstrate visual evidence of the differences that exist (Appendix A). The horizontal axes are the students' underlying trait while the vertical axis represents the scores on the test or scale; divergence shows difference in ability or response patterns.

Regarding senior students' responses, dif was detected as well however all thresholds were trivial (Table 5). Responses to items pertaining to safety, comfort at one's institution, and comfort with people knowing one's sexual orientation by students who identify as queer showed dif at pseudo R^2 .001. In another iteration, only the last item related to comfort in people knowing one's sexual orientation changed, where dif was still detected at a more rigorous pseudo R^2 value (.01); however, this is still considered trivial. Dif was also detected for Students of Color and STEM students when responding to feeling safe at their institution regarding their sexual orientation at .001. Lastly, there was dif in an item for Students of Color regarding feeling comfort about people knowing their sexual orientation at the pseudo R^2 value of .001. Similarly to first-year students, there did not seem to be any differences among seniors' responses by gender identity, ability, or first-generation status. Appendix B features test response curves and item distribution curves visually displaying dif.

Discussion

Findings indicate there do appear to be some different response patterns to items regarding students' perception of their sexual orientation in relation to their institution's support. Specifically, queer and non-queer first-year students responded differently to how comfortable they were with people knowing their sexual orientation at their institution. This leads to questions about the item: are there issues with students' understanding of the item, or are there differing latent abilities between the two populations. It is difficult to discern answers to either of these questions, yet they both potentially raise alarms. Cognitive interviews could help

researchers better understand students' familiarity with items and lead to reasons to remove the item from future use. Researchers may want to know if students have ever reflected on their sexual orientation or explored it in relation to a set of constructs. This would help further explain the variation in item responses while shedding light on differences in responses.

Dif was found in only one item. This could be attributed in part to the fact that when creating the item set the researchers were intentional in language choice, making sure both queer and non-queer students could respond. It appears the extra precautions taken during survey design were beneficial for the most part in assuring students interpreted items similarly based on their underlying latent traits. In this case, sometimes no findings are good findings. However, it is still important for survey methodologists to consider all populations who will be assessed. Even if a test may have equally distributed scores for two populations the items may be biased, making it imperative for item testing to be a common practice of researchers (Martinkova et al., 2017).

While there were no findings regarding other student characteristics the study advances the field of item measurement in a number of ways. It expands conversations of item analysis about the possibility of examining differences by additional small populations that exist in higher education. Far too often researchers overlook small populations when there may be differences that exist (BrckaLorenz et al., 2019; Garvey & Rankin, 2015; Patton, 2011). Although race is often a common group to test for dif this study shows that it is important to test additional groups. STEM majors and students who identify as queer had the same level of dif as the race group. To that end, future research may also want to observe item response differences based on the saliency of identities. It could be possible that students who find their identity more important to their understanding of the world may comprehend items differently.

Implications

As survey methodologists gain a better awareness of the intricacies of student identities it is important to continue to improve practices. Collecting demographic data pertaining to sexual orientation and gender identity will allow future studies to check for biases that may exist in items. In doing so, it is important to recognize that sexual orientation is fluid thus capturing it on a survey is often difficult (Garvey, 2019). Recommendations for future research include finding ways to better ask students about their identity. Expansive and accurate data should be emphasized to prevent misrepresenting students and their experiences (Williams Institute, 2009). In regard to analyses, dif is usually found at the group level thus little is known about the individual students responding to the items (Cohen & Bolt, 2005). Cognitive interviews and qualitative research could assist scholars in better assuring that students are understanding questions correctly prior to administering surveys. Lastly, Martinkova and colleagues (2017) remind researchers that dif may be present in the test or scale it does not necessarily mean that the associated items are unfair, thus it is important to use various measures of validity to ensure items are perceived by students the way they are intended.

Conclusion

This paper was intended to call attention to small populations that may be overlooked in the item analysis world. Items pertaining to sexual orientation were examined as it was probable that the content favored one student group over another; it was plausible that non-queer students may not have questioned their safety, belonging, or community in relation to sexual orientation. While little differences were found between queer and non-queer students one item was flagged, which serves as a reminder that students interpret items differently. DIF is introduced by an underlying construct that is obscuring the measurement of the thing that is intended to be studied

(Cohen & Bolt, 2005). Keeping the idea that student populations are socialized and experience life differently at the forefront of one's research is important in designing future assessment tools.

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Tables

Table 1. Student enrollment patterns

	Count	Column N %
Carnegie Classification		
Doc/Highest	3101	15.6%
Doc/Higher	5114	25.7%
Doc/Moderate	2948	14.8%
Master-L	2418	12.2%
Master-M	204	1.0%
Master-S	1447	7.3%
Bacc-A&S	3493	17.6%
Bacc-DIV	1176	5.9%
Barrons Selectivity		
Less competitive	786	4.4%
Competitive and competitive plus	7969	44.3%
Very competitive and very competitive plus	3670	20.4%
Highly competitive and highly competitive plus	4386	24.4%
Most competitive	1177	6.5%
Control		
Public	14926	75.0%
Private-not-for-Profit	4975	25.0%
Institution Size		
Small (1,000-2,500)	3498	17.6%
Medium (2,500-4,999)	2690	13.5%
Large (5,000-9,999)	3027	15.2%
Very Large (10,000 or more)	10686	53.7%

Table 2. Student characteristics

	Count	Column %
Race/Ethnicity		
American Indian or Alaska Native	41	0.3
Asian	1787	11.8
Black or African American	1305	8.6
Hispanic or Latino	1486	9.8
Native Hawaiian or Other Pacific Islander	44	0.3
White	8420	55.5
Other	277	1.8
Multiracial	1246	8.2
I prefer not to respond	567	3.7
Race/Ethnicity Recode		
Students of color	5909	41.2
Non-students of color	8420	58.8
Gender		
Man	5113	33.5
Woman	9760	64.0
Another gender identity	168	1.1
Prefer not to respond	215	1.4
Gender Recode		
Trans & Nonbinary	168	1.1
Non-trans	14873	98.9
Sexual Orientation		
Straight (heterosexual)	12789	84.2
Bisexual	743	4.9
Gay	291	1.9
Lesbian	158	1.0
Queer	175	1.2
Questioning or unsure	210	1.4
Another sexual orientation, please specify	221	1.5
I prefer not to respond	609	4.0
Sexual Orientation Recode		
Queer	1798	12.3
Non-queer	12789	87.7
Class		
First-year	5873	43
Senior	7878	57
Disability		
No	13294	87.5
Yes	1904	12.5
First Generation		
No	8948	58.9
Yes	6232	41.1
STEM		
No	10929	72.0
Yes	4259	28.0

Table 3. Descriptives

		N	Min.	Max.	Mean	Std. Error	SD	α
With respect to your sexual orientation (straight, LGBQ+, etc.), agree/disagree:	I feel physically safe at my institution.	14244	1.00	6.00	5.25	0.01	0.89	.817
	I feel comfortable being myself at my institution	14247	1.00	6.00	5.21	0.01	0.98	
	I feel valued by my institution.	14225	1.00	6.00	4.75	0.01	1.23	
	I feel like part of the campus community.	14214	1.00	6.00	4.59	0.01	1.32	
In general, how comfortable are you with people at this institution knowing your sexual orientation?		14094	1.00	6.00	5.40	0.01	1.02	
Institutional Support Scale		14241	0.00	50.00	40.38	0.07	8.38	

Table 4. DIF in First Year Students' Responses

		Sexual Orientation	Gender Identity	Race	STEM	Disability	First-Generation
With respect to your sexual orientation (straight, LGBQ+, etc.), agree/disagree:	I feel physically safe at my institution.	0.001		0.001	0.001		
	I feel comfortable being myself at my institution	0.001					
	I feel valued by my institution.	0.001					
	I feel like part of the campus community.	0.001					
In general, how comfortable are you with people at this institution knowing your sexual orientation?		0.035		0.001			

Values indicate where DIF was found for the item at threshold

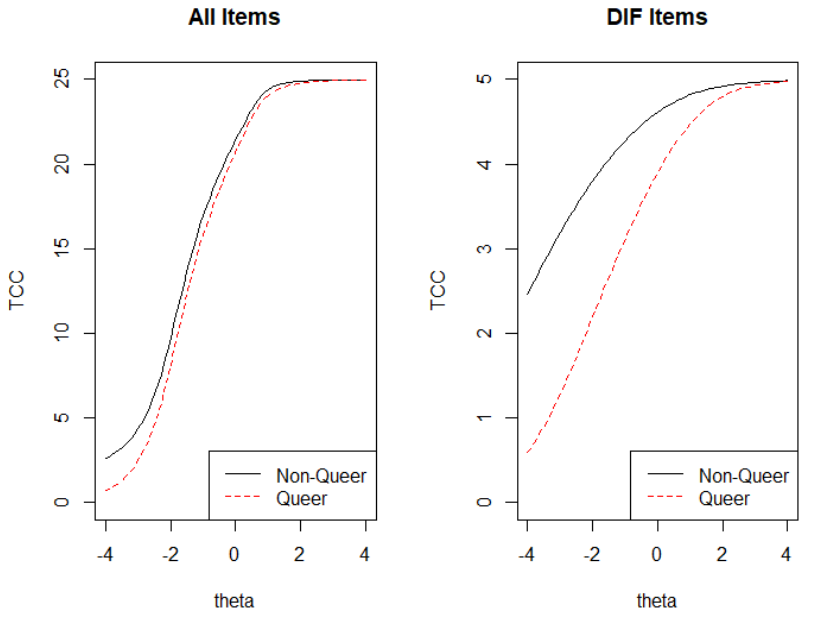
Table 5. DIF in Senior Students' Responses

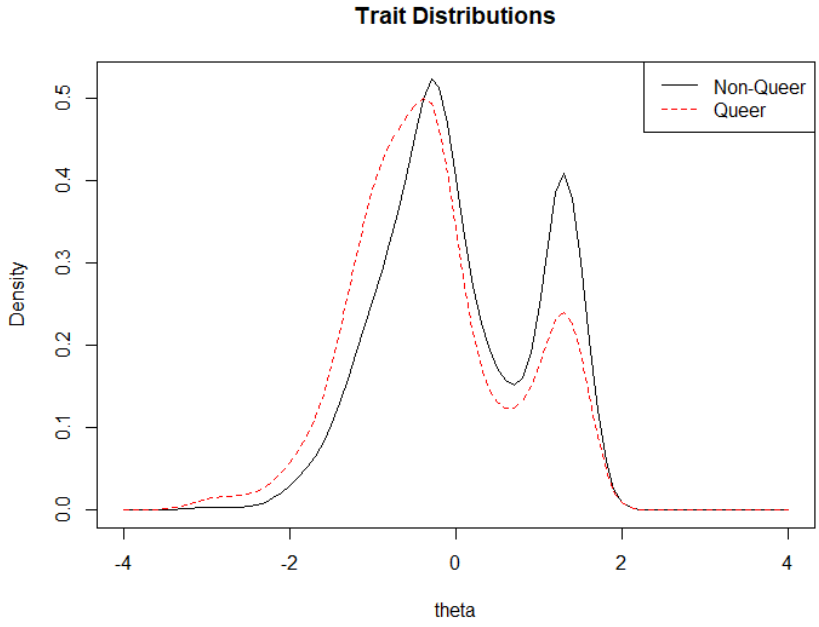
		Sexual Orientation	Gender Identity	Race	STEM	Disability	First-Generation
With respect to your sexual orientation (straight, LGBQ+, etc.), agree/disagree:	I feel physically safe at my institution.	0.001		0.001	0.001		
	I feel comfortable being myself at my institution	0.001					
	I feel valued by my institution.						
	I feel like part of the campus community.						
In general, how comfortable are you with people at this institution knowing your sexual orientation?		0.01		0.001			

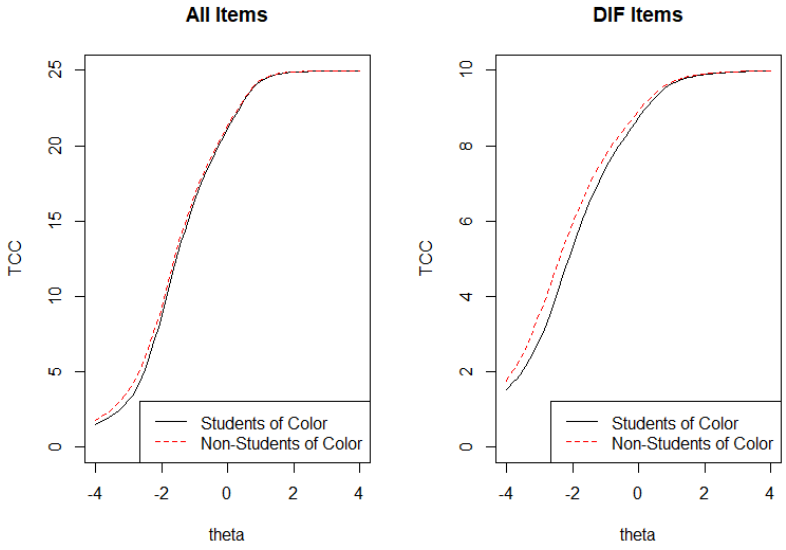
Values indicate where DIF was found for the item at threshold

Appendix

A. First Year Students



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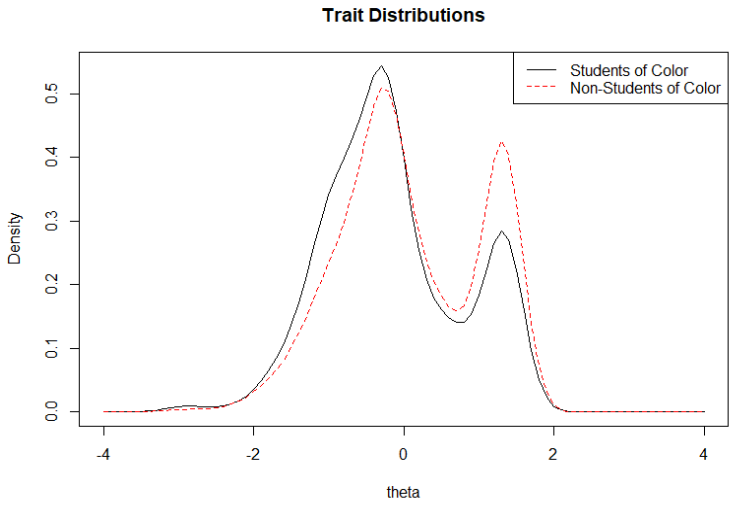
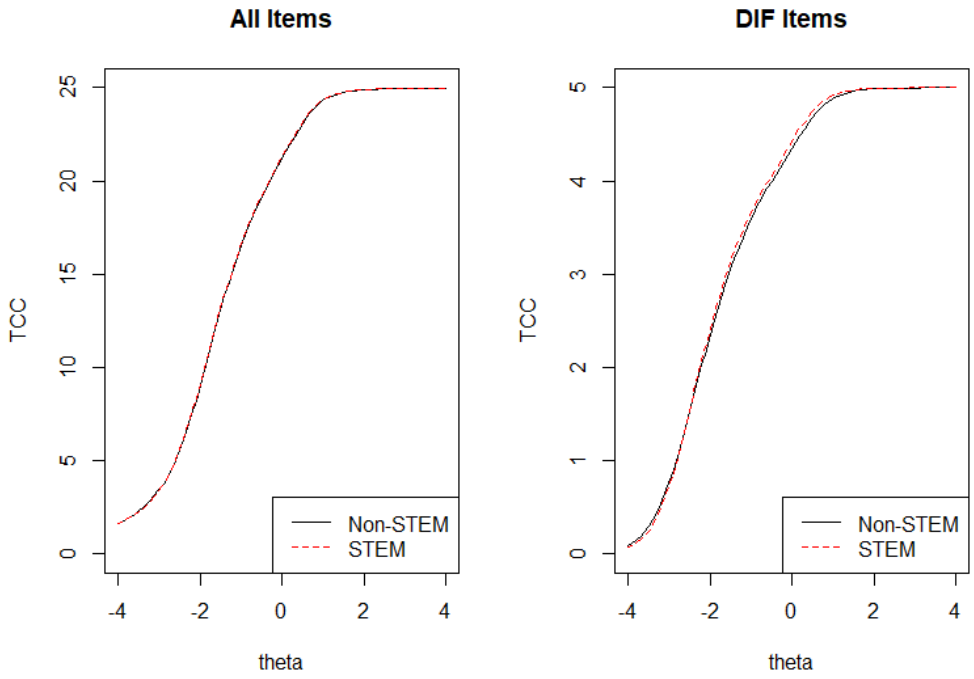
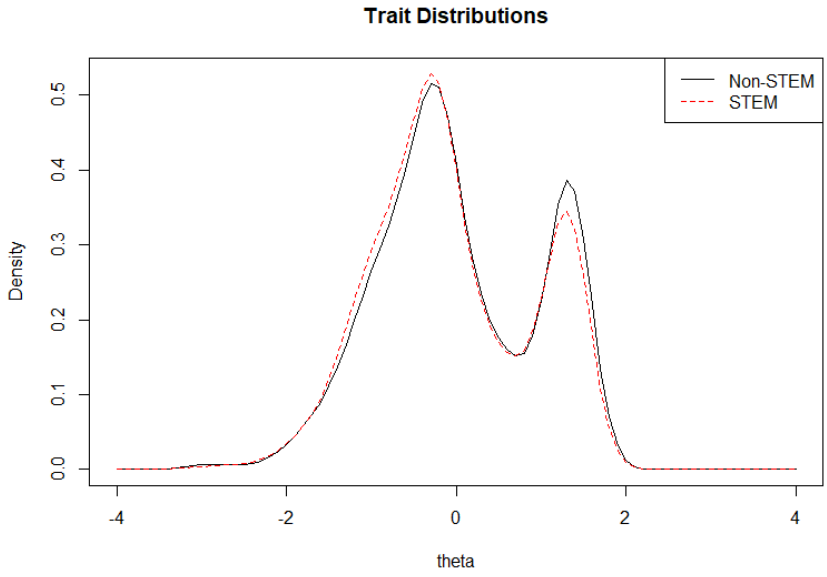
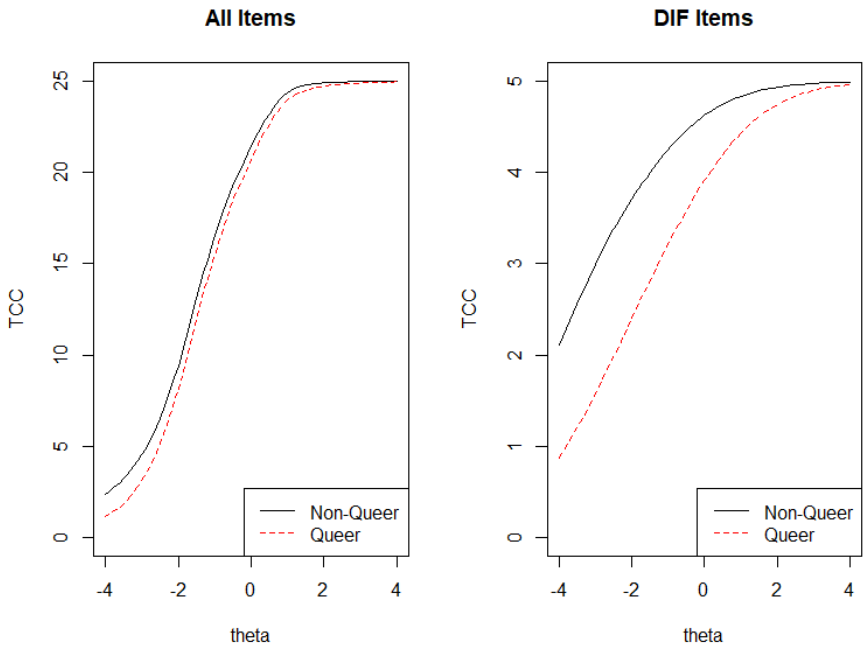
theta
Students of Color
Non-Students of Color
DIF Items
TCC
theta
Students of Color
Non-Students of Color

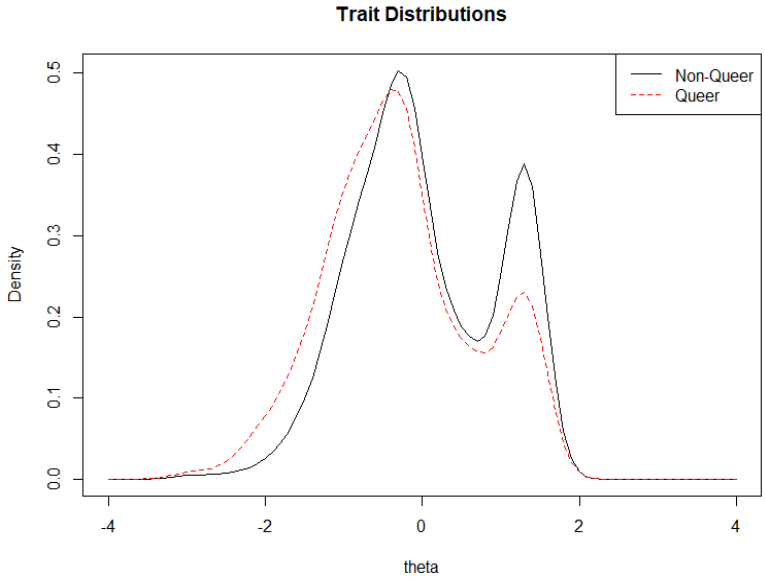

Trait Distributions
Density
theta
Students of Color
Non-Students of Color

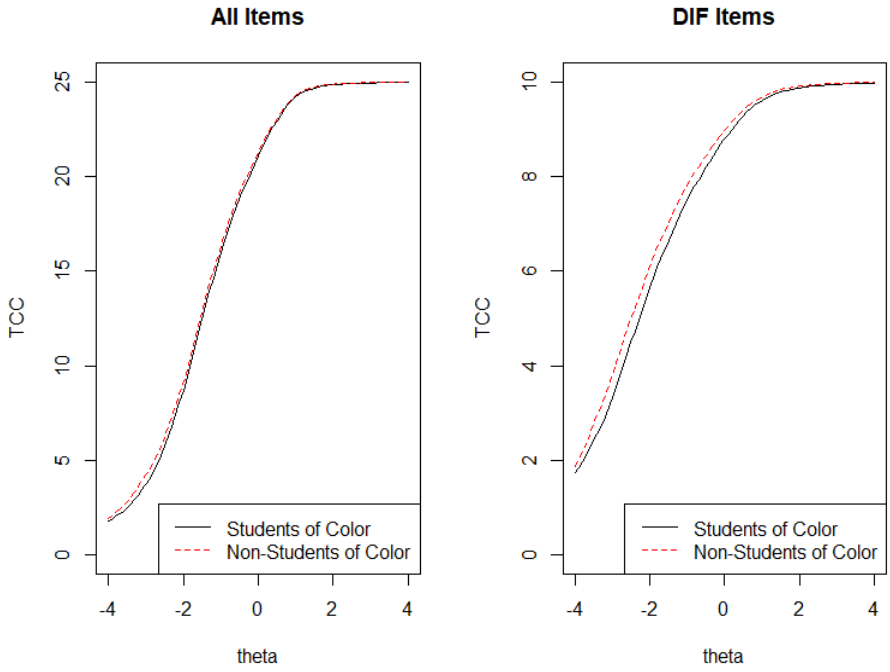

All Items
TCC
theta
Non-STEM
STEM
DIF Items
TCC
theta
Non-STEM
STEM


Trait Distributions
Density
theta
Non-STEM
STEM

B. Senior Students






All Items
TCC
theta
Students of Color
Non-Students of Color
DIF Items
TCC
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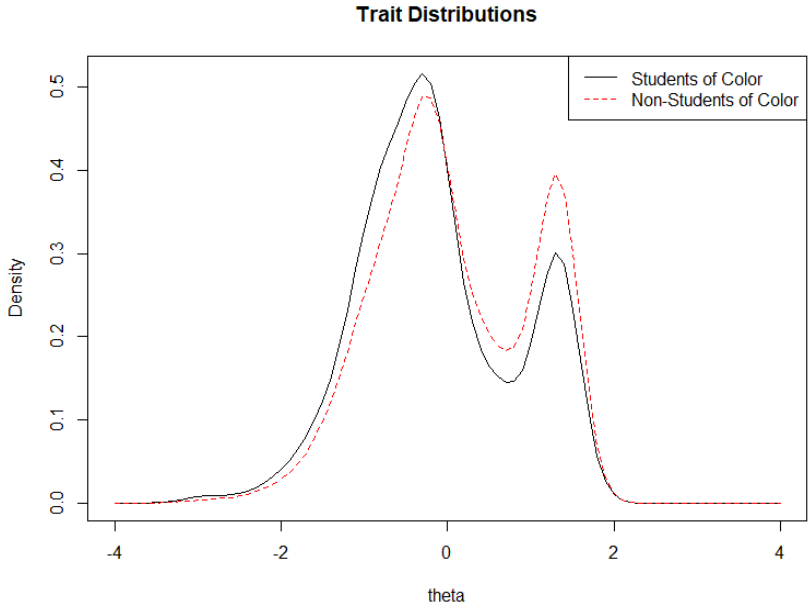
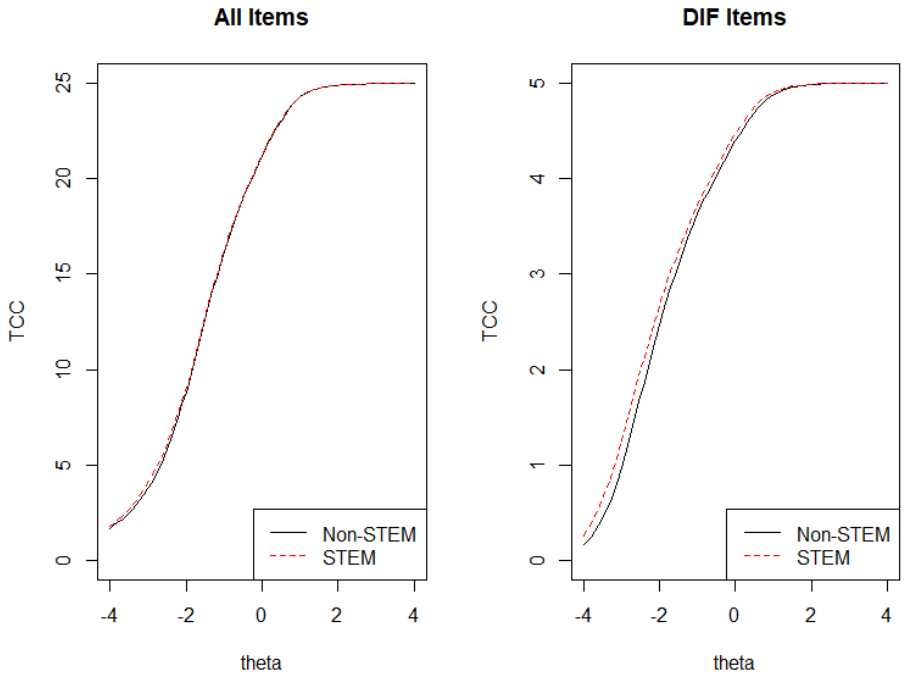
Students of Color
Non-Students of Color


Trait Distributions
Density
theta
Students of Color
Non-Students of Color


All Items
TCC
theta
Non-STEM
STEM
DIF Items
TCC
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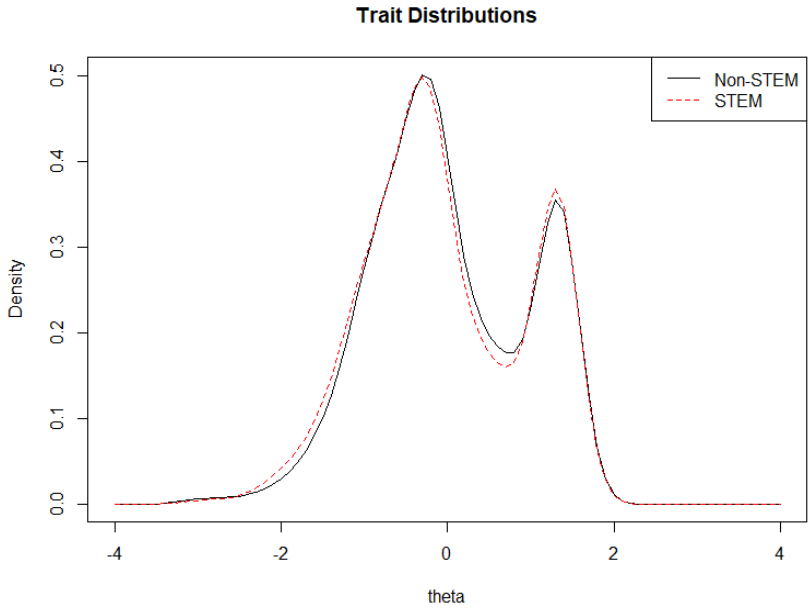
STEM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